

Screening Level Assessment of Risks Due to Dioxin Emissions from Burning Oil from the BP Deep Water Horizon Gulf of Mexico Spill

As one of the methods to respond to the oil spill, 410 separate *in-situ* burns were carried out between April 28 and July 19, burning an estimated 222,000-313,000 barrels of oil (~5% of the total amount of leaked oil)



Dioxin Risk?

- Polychlorinated dibenzo-p-dioxins and furans (referred to as PCDD/F or “dioxin”) are formed in trace amounts during combustion
- The presence of chlorine in the combustion environment can enhance PCDD/F formation
- The marine environment has relatively high levels of chlorine, and so there was concern that the oil burning activities might be releasing harmful levels of dioxin
- There are 209 different PCDD/F congeners; 2,3,7,8-TCDD is the most toxic and is one of the most potent carcinogenic compounds ever discovered



A joint “screening level” project was undertaken by the EPA and NOAA to assess the potential dioxin risk from the oil burning activities

Overall Outline of Project

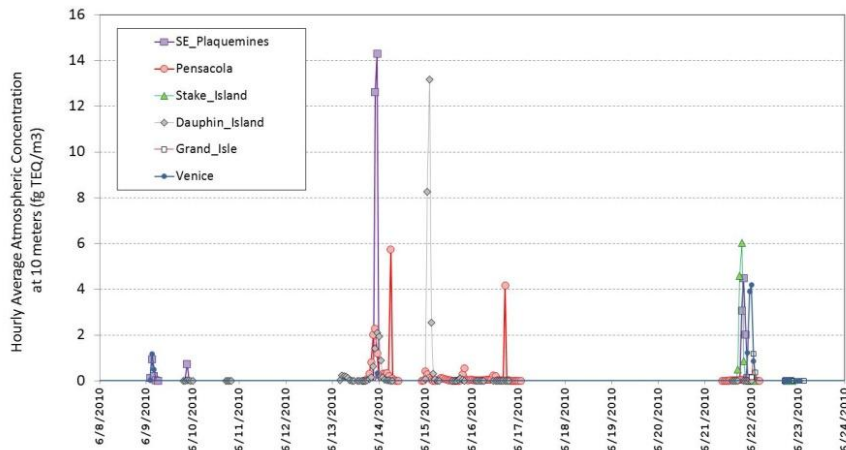
- Overall goal was to estimate inhalation risk to workers and residents, as well as risk from consumption of dioxin-contaminated seafood
- This was a screening level analysis -- if the risks appeared high enough, a more detailed assessment would be carried out
- Dioxin was measured in DWH-oil-burning plumes by EPA to estimate emissions factor
- Relevant burn-by-burn data and meteorological data were assembled for use as model inputs
- Atmospheric dispersion models used to estimate air concentrations of dioxin downwind of the burns; inhalation exposure and cancer risks from this exposure were based on these estimates.
- Atmospheric deposition was estimated by dispersion models and utilized in a food chain model to estimate dioxin concentrations in fish; cancer risk from fish consumption based on these estimates.

NOAA ARL's Contributions

- Carrying out analysis on burn-by-burn data to create a dataset suitable for model input. (ARL appreciates the assistance of NOS/OR&R in relaying these data.)
- Assembling/archiving gridded meteorological data for use in ARL's atmospheric modeling; extracting data from these archives to support EPA's near-field modeling work
- NOAA ARL was asked by U.S. EPA to begin modeling atmospheric fate and transport of emitted dioxin on June 18, 2010 to inform assessment of risks to the general population. Numerous model runs were carried out over the next four months as additional data became available.
- This ARL atmospheric modeling analyzed the regional fate and transport of emitted dioxin, on a congener-specific and burn-by-burn basis, using a specially configured version of the HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory) model designed to simulate atmospheric PCDD/F.
- Based on this modeling, ARL provided screening-level values of atmospheric deposition and on-shore concentrations for use in the EPA's risk assessment

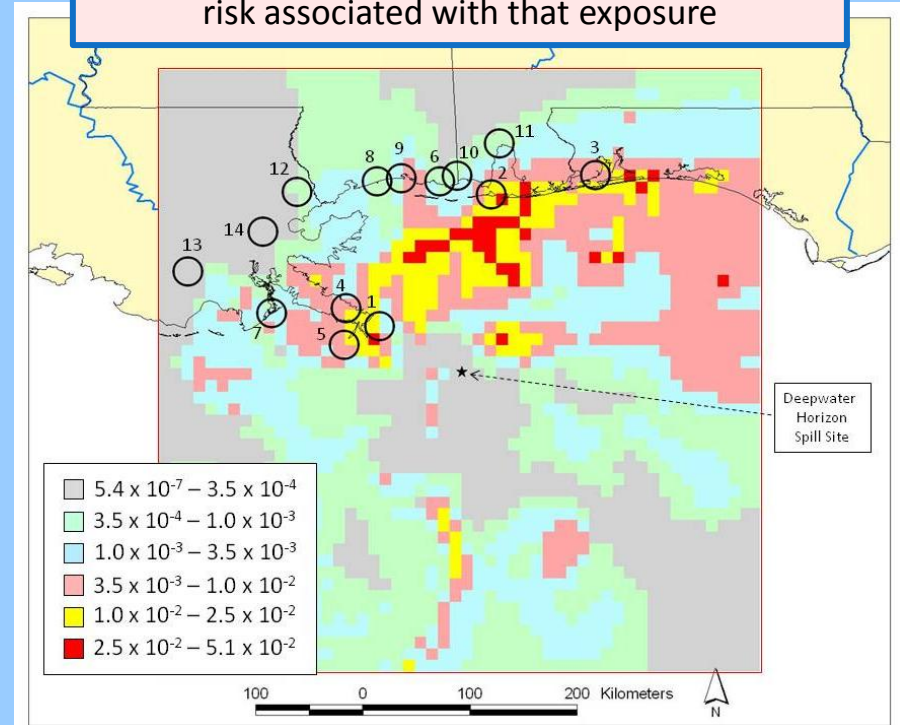
Ground-Level Atmospheric Concentrations

Ground-level dioxin concentrations were very episodic, due to the fact that burns occurred sporadically and the weather was highly variable



Time series of modeled hourly average PCDD/F concentrations (at 10 meter elevation) for a portion of the burning period (June 8-24) at several illustrative locations in the Gulf of Mexico region resulting from estimated dioxin emissions from reported burn events.

These data were used by EPA used to estimate on-shore inhalation exposure and the cancer risk associated with that exposure



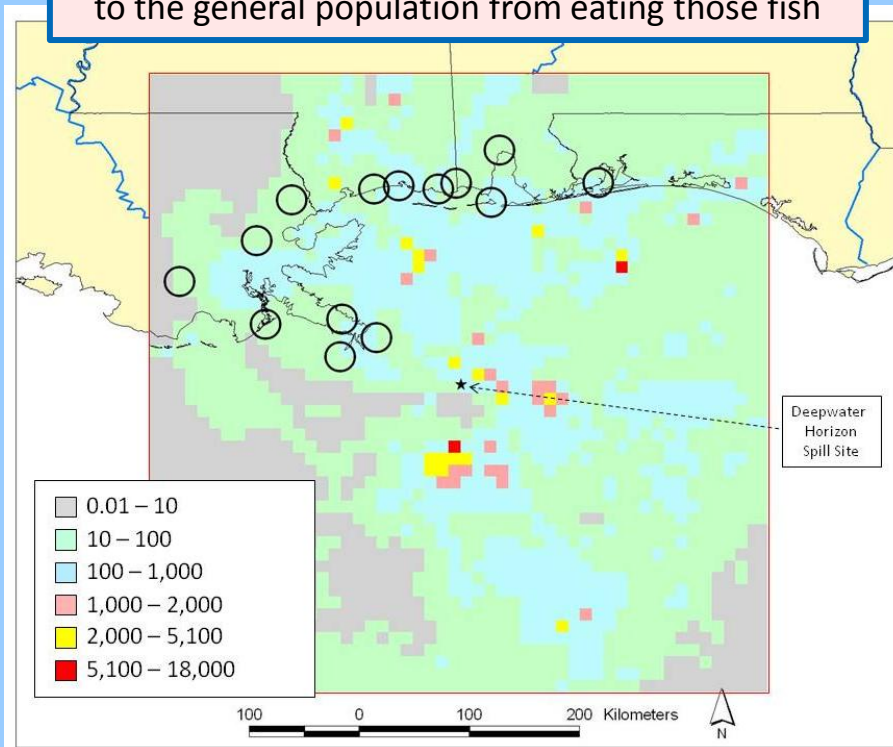
Average modeled ground-level PCDD/F concentrations (fg TEQ/m³) over the entire modeling period April 28 – July 22, 2010.

Illustrative locations shown, numbered in descending order from highest to lowest average concentration (fg TEQ/m³):

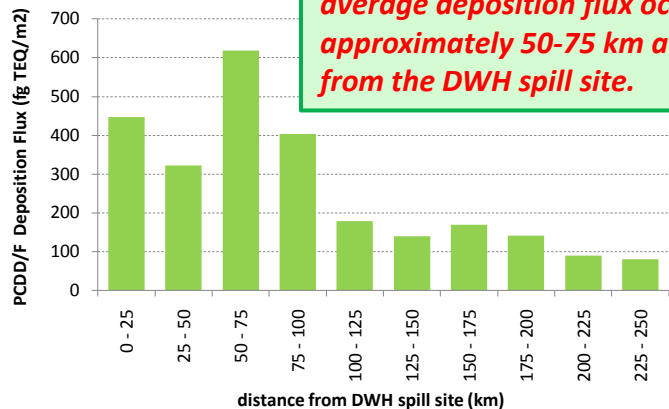
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|------------------------------|-------------------------------|
| 1 – S.E. Plaquemines (0.019) | 8 – Gulfport (0.00095) |
| 2 – Dauphin Island (0.016) | 9 – Biloxi (0.00066) |
| 3 – Pensacola (0.012) | 10 – Grand Bay NERR (0.00065) |
| 4 – Venice (0.0072) | 11 – Mobile (0.00052) |
| 5 – Stake Island (0.0069) | 12 – Slidell (0.00025) |
| 6 – Pascagoula (0.0011) | 13 – Houma (0.00018) |
| 7 – Grand Isle (0.0010) | 14 – New Orleans (0.00008) |

Atmospheric Deposition

EPA used these data as input to a food chain model to estimate dioxin concentrations in fish and risks to the general population from eating those fish

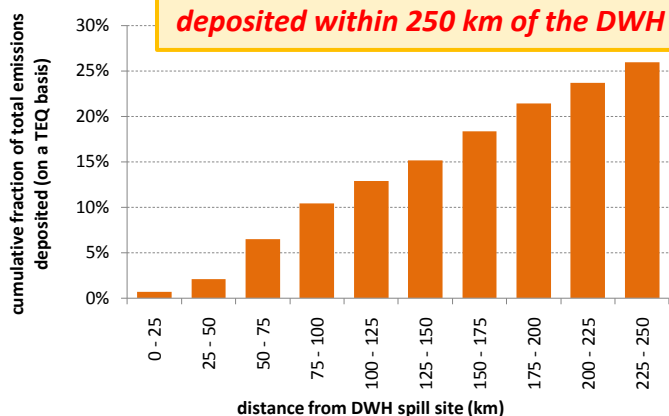


Total PCDD/F deposition flux (fg TEQ/m2) over the entire modeling period April 28 – July 22, 2010.



Due to plume rise, the highest average deposition flux occurred approximately 50-75 km away from the DWH spill site.

Average Dioxin Deposition Flux (fg TEQ/m2) at Different Distances Away from the DWH Spill Site

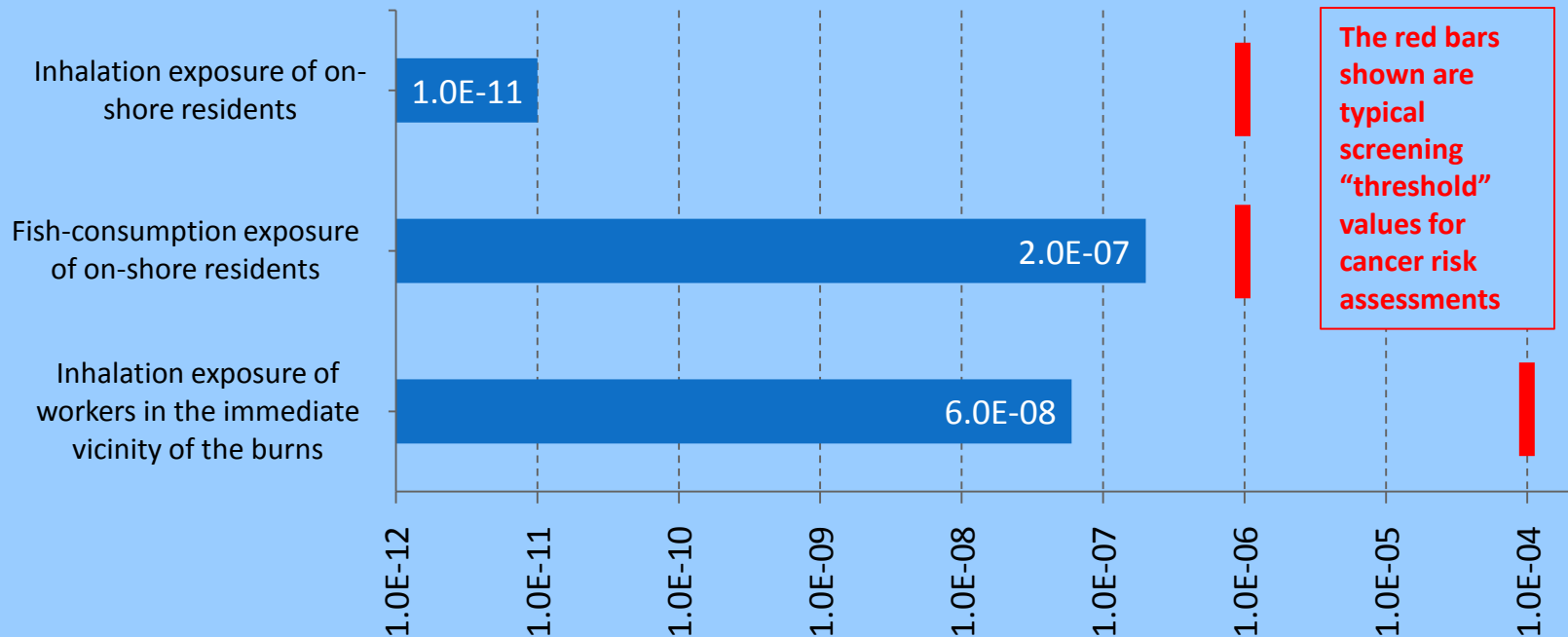


~25% of the emitted PCDD/F was deposited within 250 km of the DWH site

Cumulative Fraction of Dioxin Emissions Deposited at Different Distances Away from the DWH Spill Site



Upper-bound lifetime incremental cancer risk



Current Status (Oct 14, 2010)

- A manuscript has been prepared and has undergone Internal (EPA and NOAA) and External peer reviews
- EPA is now considering how to release these data. Options being considered are publication on the EPA web site and/or submission of the manuscript to a journal, e.g., *Environmental Science and Technology*

Issues

- This risk assessment was for dioxin emissions only. It did not consider other chemicals likely emitted, e.g., PAH's (polycyclic aromatic hydrocarbons).
- This risk assessment only considered emissions from in-situ oil burning. It did not consider emissions from other DWH-related oil-burning activities, e.g., on the Q-4000.
- There were significant uncertainties in available information about the characteristics (e.g., area of burn, plume rise) of individual burn events. For future incidents, additional information (e.g., photo's of plumes) would improve accuracy of risk assessments